04-05-02 10089985 .040302 PCT

JC05 Rec'd PCT/PTO 03 APR 2002

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U S.C. 371	ATTORNEY'S DOCKET NO. 11001.094
	U.S. APPLICATION NO. 10/089985

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FI00/00861	6 October 2000	6 October 1999; 20 January 2000

TITLE OF INVENTION
METHOD FOR ANALYZING A PAPERMAKING PROCESS AND AN ELECTROCHEMICAL SENSOR FOR ANALYZING LIQUID

APPLICANT(S) FOR DO/EO/US

Sakari Laitinen-Vellonen

Applicant herewith submits to the United States Designated Elected Office (DO/EO/US) the following items and other information.

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.

3. ☐ This express request to begin national examination procedures (U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in U.S.C. 371(b) and PCT Articles 22 and 39

4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority.

5. ☒ A copy of the International Application as filed (35 U.S.C. 37(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau)
   b. ☒ has been transmitted by the International Bureau
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)

6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).

7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b ☒ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.

8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. ☒ A **FIRST** preliminary amendment.
    ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.

14. ☐ A substitute specification

15. ☐ A change of power of attorney and/or address letter.

16. ☐ Other items or information:

17. ☒ The following fees are submitted.

		CALCULATIONS
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO	$ 890.00	$
International preliminary examination fee paid to USPTO (37 CFR 1.482)	$ 710 00	
No international preliminary examination fee paid to USPTO (37 CFR 1.492) but international search fee paid to USPTO (37 CFR 1.445(a)(2))	$ 740.00	
Neither international preliminary examination fee (37 CFR 1 492) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$ 1040.00	$ 1040.00
International preliminary examination fee paid to USPTO (37 CFR 1.492) and all claims satisfied provisions of PCT Article 33(2)-(4)	$ 100 00	
ENTER APPROPRIATE BASIC FEE AMOUNT =		$ 1040.00

Surcharge of $ 130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e))			=		$
Claims	Number Filed	Number Extra	Rate		
Total Claims	13- 20 =	0	x	$ 18.00	$
Independent Claims	2 - 3 =	0	x	$ 84.00	$
Multiple dependent claim(s) (if applicable)		0	+	$	$
TOTAL OF ABOVE CALCULATIONS			=		$ 1040.00
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1 9 1 27 1 28) Applicant claims Small Entity Status.					$ - 00
SUBTOTAL			=		$ .00
Processing fee of $ **130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1 492(f)).			+		$
TOTAL NATIONAL FEE			=		$ .00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3 28 3 31) $ 40.00 per property			+		$
TOTAL FEES ENCLOSED			=		$ 1040 00

a. ☒ A check in the amount of $1040.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☐ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. _____. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

"Express Mail" mailing label No. EU196914138US
Date of Deposit: April 3, 2002

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C 20231

Chris J. Fildes

SEND ALL CORRESPONDENCE TO.

Chris J. Fildes
SIGNATURE

Christopher J. Fildes, Fildes & Outland,
20916 Mack Ave., Ste. 2, Grosse Pte. Wds.,
MI 48236 (313) 885-1500

32,132
REGISTRATION NUMBER

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE UNDER THE PATENT COOPERATION TREATY BEFORE THE UNITED STATES DESIGNATED/ELECTED OFFICES

In regard to international application:

Serial No. PCT/FI00/00861

Applicants: Sakari Laitinen-Vellonen

Filing Date: October 6, 2000

Title: METHOD FOR ANALYZING A PAPERMAKING PROCESS AND AN ELECTROCHEMICAL SENSOR FOR ANALYZING LIQUID

Attorney Docket No. 11001.094

To: Assistant Commissioner for Patents
Washington, D.C. 20231

I hereby certify that this correspondence is being deposited with the United States Postal Service as express mail, no. EU196914138US in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on

April 3, 2002
Date of Deposit

Christopher J. Fildes
Registered Attorney

Signature

PRELIMINARY AMENDMENT

Sir:

In connection with entry into the National Phase in the United States of the above referenced application, please amend the application as follows:

In the Specification:

P. 1, line 3, insert the heading
-- Technical Field --;

P. 1, line 16, insert the heading
-- Background of the Invention --;

P. 2, line 11, insert the heading

-- Summary of the Invention --;

Replace the paragraph beginning on P. 2, line 17, with the following paragraphs

-- The characteristic features of the method according to the invention include analyzing a papermaking process, in which several electrochemical quantities are measured from at least one liquid flow and fingerprints according to various process situations are determined, to which the fingerprints obtained in a normal process situation are compared and the differences in the output variables created by an essential change are determined, and is characterized in that the electrochemical measurements are carried out independently of each other using at least 4 - 15 electrode series, each comprising at least three electrodes, one common bias-electrode for all series and, in addition, at least one odor measurement is used from the gases that are emitted from the said liquid flow into the gas space over the free liquid surface.

The characteristic features of the electrochemical sensor to be used in the method include an electrochemical, i.e. polarographic/galvanostatic sensor for analyzing a liquid, in which sensor there is a measurement cell, through which the liquid is led and in which there are several working electrodes of different material and reference-electrodes and a current-supplying counter-electrode, and a pre-amplifier to amplify a weak measurement signal, and is characterized in that the electrodes are arranged in electrode series, each series including at least a working electrode, a reference electrode and a counter-electrode, and there is a common bias-electrode for all electrode series, which is a fourth electrode in each series, and there are 4 - 15 electrode series, each series having a pre-amplifier with a minimized connection distance.

Electrochemical measurements provide certain voltage levels. According to the invention, what substances or compounds create the responses obtained are not, as such generally determined, though this is, as such, possible. Instead, so-called 'fingerprints' for specific process situations are obtained from the measurements.

These can correspond to either good or bad situations. The scope of application of the method expands considerably if, in addition to the electrochemical measurements of the liquid flow, odor measurements are made from the gas released from the liquid flow. This is because it has been observed that the powerful effects of some compound may be easily visible from the 'odor vector', even though a relatively faint response is detected when investigating the liquid. Such odor vectors are provided by, for example, bacterial growths, extractives, or certain surfacing substances. The odor is studied from the liquid in such a way that the vapor of the liquid is allowed to be released, for example, into an air space, in which an odor sensor is located. One such odor sensor is disclosed in, for example, WO publication 97/05476. It is often advantageous to measure the odor sample at different temperatures, for example, at 50°C, 70°C, and 100°C. --

P. 3, line 28, insert the heading
-- Brief Description of the Drawings --;

P. 4, line 4, insert the heading
-- Detailed Description of the Invention --;

P. 9, line 28, insert the paragraph
-- Although the invention has been described by reference to a specific embodiment, it should be understood that numerous changes may be made within the spirit and scope of the inventive concepts described. Accordingly, it is intended that the invention not be limited to the described embodiment, but that it have the full scope defined by the language of the following claims. --;

In the Claims:

Cancel claims 1-13 and add claims 14-26 as follows:

14. A method for analyzing a papermaking process, in which several electrochemical quantities are measured from at least one

liquid flow and fingerprints according to various process situations are determined, to which the fingerprints obtained in a normal process situation are compared and the differences in the output variables created by an essential change are determined, characterized in that the electrochemical measurements are carried out independently of each other using at least 4 - 15 electrode series, each comprising at least three electrodes, one common bias-electrode for all series and, in addition, at least one odor measurement is used from the gases that are emitted from the said liquid flow into the gas space over the free liquid surface.

15. A method according to Claim 14, characterized in that the odor measurements are made in at least two temperature ranges.

16. A method according to Claim 14, characterized in that the measurements are made from at least one liquid flow containing fibers and the measurement channels are arranged to be sufficiently spacious so that liquid containing fibers can pass through them without causing a danger of blockage.

17. A method according to Claim 14, characterized in that there are six electrochemical electrode series and their outlet channels are connected together in pairs and these pairs are connected in turn through a flow meter to a common outlet line.

18. An electrochemical, i.e. polarographic/galvanostatic sensor for analyzing a liquid, in which sensor there is a measurement cell, through which the liquid is led and in which there are several working electrodes of different material and reference-electrodes and a current-supplying counter-electrode, and a pre-amplifier to amplify a weak measurement signal, characterized in that the electrodes are arranged in electrode series, each series including at least a working electrode, a reference electrode and a counter-electrode, and there is a common bias-electrode for all electrode series, which is a fourth electrode in

each series, and there are 4 - 15 electrode series, each series having a pre-amplifier with a minimized connection distance.

19. A sensor according to Claim 18, characterized in that the electrode series are placed in measurements channels branching out radially of an intake channel and a common bias electrode in the center of the intake channel.

20. A sensor according to Claim 18, characterized in that the material of at least one electrode belongs to the group consisting of platinum, gold, silver, iron Fe_3, iron Fe_2, stainless steel, molybdenum, zinc, titanium, cadmium, copper, glass, electrically-conductive plastic, and ceramics.

21. A sensor according to Claim 18, characterized in that the pre-amplifier connected to each series is located in the space between the electrode series in the immediate vicinity of each electrode series.

22. A sensor according to Claim 21, characterized in that the sensor includes an electrode cover covering the radial channels on at least one side, to which the electrodes are attached to extending into the said channels and on the other side extending to a special electronic circuit card, in which the said pre-amplifiers are installed.

23. A sensor according to Claim 22, characterized in that a protectively ground cylinder, which extends over at least one-third of the depth of the electrode cover, is fitted around the electrodes on the circuit card side.

24. A sensor according to Claims 18, characterized in that the sensor pipes are arranged in such a way that liquid remains around the sensors during a shutdown.

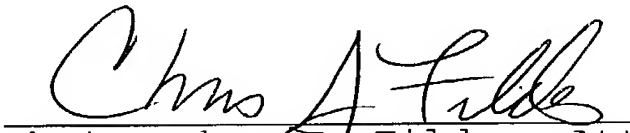
25. A sensor according to Claim 19, characterized in that the radial channels have a diameter of 0.3 - 3 cm, and each electrode protrudes into the channel in such a way that the speed of flow increases substantially at it.

26. A sensor according to Claim 19, characterized in that the electrode in the center of the intake channel is a high-speed temperature sensor.

In The Abstract:

Insert the Abstract being provided on a separate sheet.

Respectfully submitted,
Sakari Laitinen-Vellonen
Fildes & Outland, P.C.



Christopher J. Fildes, Attorney
Registration No. 32,132
20916 Mack Avenue, Suite 2
Grosse Pointe Woods, MI 48236
(313) 885-1500

AMENDMENTS

Version with markings to show changes made

Replace the paragraph beginning on P. 2, line 17, with the following paragraphs

-- The characteristic features of the method according to the invention [are stated in the accompanying Claim 1] include analyzing a papermaking process, in which several electrochemical quantities are measured from at least one liquid flow and fingerprints according to various process situations are determined, to which the fingerprints obtained in a normal process situation are compared and the differences in the output variables created by an essential change are determined, and is characterized in that the electrochemical measurements are carried out independently of each other using at least 4 - 15 electrode series, each comprising at least three electrodes, one common bias-electrode for all series and, in addition, at least one odor measurement is used from the gases that are emitted from the said liquid flow into the gas space over the free liquid surface.

[and t]The characteristic features of the electrochemical sensor to be used in the method [are stated in Claim 5] include an electrochemical, i.e. polarographic/galvanostatic sensor for analyzing a liquid, in which sensor there is a measurement cell, through which the liquid is led and in which there are several working electrodes of different material and reference-electrodes and a current-supplying counter-electrode, and a pre-amplifier to amplify a weak measurement signal, and is characterized in that the electrodes are arranged in electrode series, each series including at least a working electrode, a reference electrode and a counter-electrode, and there is a common bias-electrode for all electrode series, which is a fourth electrode in each series, and there are 4 - 15 electrode series, each series having a pre-amplifier with a minimized connection distance.

Electrochemical measurements provide certain voltage levels. According to the invention, what substances or compounds create the

responses obtained are not, as such generally determined, though this is, as such, possible. Instead, so-called 'fingerprints' for specific process situations are obtained from the measurements. These can correspond to either good or bad situations. The scope of application of the method expands considerably if, in addition to the electrochemical measurements of the liquid flow, odor measurements are made from the gas released from the liquid flow. This is because it has been observed that the powerful effects of some compound may be easily visible from the 'odor vector', even though a relatively faint response is detected when investigating the liquid. Such odor vectors are provided by, for example, bacterial growths, extractives, or certain surfacing substances. The odor is studied from the liquid in such a way that the vapor of the liquid is allowed to be released, for example, into an air space, in which an odor sensor is located. One such odor sensor is disclosed in, for example, WO publication 97/05476. It is often advantageous to measure the odor sample at different temperatures, for example, at 50°C, 70°C, and 100°C. --

METHOD FOR ANALYZING A PAPERMAKING PROCESS AND AN ELECTROCHEMICAL SENSOR FOR ANALYZING LIQUID

Abstract

A method for analyzing a papermaking process is disclosed in which several electrochemical quantities are measured from at least one liquid flow and fingerprints according to good process situations are determined. The electrochemical measurements are carried out independently of each other using at least three electrode series, each including at least three electrodes. In addition, at least one odor measurement is used from the gases that are emitted from the liquid flow into the gas space over the free liquid surface.

METHOD FOR ANALYSING A PAPERMAKING PROCESS AND AN ELECTROCHEMICAL SENSOR FOR ANALYSING LIQUID

The present invention relates to a method for analysing a papermaking process, in which several electrochemical quantities are measured from at least one liquid flow in the process and various fingerprints according to the process situation are defined, to which the fingerprints obtained in a normal process situation are compared and the differences creating an essential difference in the initial quantities are defined. The invention also relates to, for implementing the method, an electrochemical, i.e. polarographical/galvanostatic sensor for analysing liquid. The invention particularly relates to papermaking processes, but the study of environmental waters, for example, may also be considered.

Neural networks, i.e. neural calculation, is used for the analysis of various processes. One known neural network model is SOM (self oriented map). Such algorithms are used to form a database from the vectors of the output variables, with the aid of various process situations. Measurement vectors, which are compared with the vectors in the database, are calculated from the measurement values obtained in the process situation. If these deviate by certain criteria from all the vectors, an attempt is made to analyse what difference or differences in the output variables caused the difference in question.

Often when applying the neural network technique, a large number of process variables are included, but the results are not satisfactory. Apparently, some of the output variables have been particularly unstable, in which case they have upset the study, and have not properly represented the process situation.

Patent publications US 4,818,348; 4,830,343; 5,393,399; 5,654,497; and EP 692711 disclose some liquid analysers that use polarographic sensors. In the first publication referred

to, the liquid is vaporized and the vapour is led through parallel sensors. Finnish patent application 892351 also discloses a disposal electrochemical sensor, which is intended for medical use. The generally known sensors have a narrow area of application and they are usually only able to measure a few predefined substances and their contents in a liquid. A sensor according to publication US 5,830,343 will not remain in operating condition for long, because even individual fibres can cause a short-circuit between the electrodes of the tiny sensor.

The present invention is intended to create a new kind of method and electrochemical sensor for it, in which the method provides better and more stable results that previous solutions.

The characteristic features of the method according to the invention are stated in the accompanying Claim 1 and the characteristic features of the electrochemical sensor to be used in the method are stated in Claim 5. Electrochemical measurements provide certain voltage levels. According to the invention, what substances or compounds create the responses obtained are not, as such generally determined, though this is, as such, possible. Instead, so-called 'fingerprints' for specific process situations are obtained from the measurements. These can correspond to either good or bad situations. The scope of application of the method expands considerably if, in addition to the electrochemical measurements of the liquid flow, odour measurements are made from the gas released from the liquid flow. This is because it has been observed that the powerful effects of some compound may be easily visible from the 'odour vector', even though a relatively faint response is detected when investigating the liquid. Such odour vectors are provided by, for example, bacterial growths, extractives, or certain surfacing substances. The odour is studied from the liquid in such a way that the vapour of the liquid is allowed

to be released, for example, into an air space, in which an odour sensor is located. One such odour sensor is disclosed in, for example, WO publication 97/05476. It is often advantageous to measure the odour sample at different temperatures, for example, at 50°C, 70°C, and 100°C.

Electrochemical measurements generally require the stabilization of the sample and often the use of several pairs of electrodes, but in this case this is not necessary, as long as the changes are measured and the data obtained is used in neural network calculation. The measurement cells formed by the pairs of electrodes, and generally also the pH and temperature sensors form a basic result space of the sample, to which the data from the odour measurements are added. Preferably, the electrochemical measurements are made in a multi-sensor matrix, in which the pairs of electrodes are arranged radially in relation to the input channel, in which a common bias-electrode is located. By this means, the measurements do not interfere with each other and the liquid has the same properties in each measurement. There are at least three, and preferably four electrodes in the series. There are at least three measurement cells, if an odour sensor is included, otherwide 4 - 15, preferably 6 - 10.

In the following, the invention is illustrated by reference to the accompanying figures, which show one method according to the invention and the sensor and program used in it.

Figure 1 shows a neural network model for analysing a process
Figure 2 shows the flow chart of an electrochemically measured liquid
Figure 3 shows a cross-section of a multi-detector sensor
Figure 4 shows a transverse section of the multi-detector sensor of Figure 3 at the point IV - IV of Figure 3
Figure 5 shows a top view of the rotameter system of the sensor of Figure 3

Figure 6 shows the rotameter system of the sensor of Figure 3
Figure 7 shows the electronic circuit card of the multi-detector sensor

The measurement apparatus according to the invention comprises an intelligent on-line sensor, by means of which monitored substances that have dissolved in liquid taken from the process and changes in their contents are detected, without, however, identifying these substances. Process situation detection is based on electrochemical phenomena taking place in the working electrodes, on measurements of pH and temperature, and on artificial intelligence implemented with the aid of a computer, which exploits a predetermined database and selected additional information. This may be the plant's normal process data and/or odour measurements from the same liquid.

The detection, according to Figure 1, of process situations takes place on the bases of electrochemical, odour measurement, and process data. The selected data are entered in a neural-network program (SOM or some other neural network program), in which a directional vector is formed in multidimensional space from the measurement results and is compared with vectors, which represent good process situations, and which are in the memory of the apparatus and have been taught to the apparatus. If the vector obtained is sufficiently close to a vector in the library, it is then identified as a good process situation, otherwise a search is made for the differences in the output variables that are causing the problem.

The vector library is formed by searching for good process situations by subjecting the system to selected process situations and saving the directional vectors obtained from them in the memory of the apparatus. The apparatus's memory may contain several hundred such directional vector 'process situation identification traces' formed from these sensor signals. The selection of good process situations can naturally

also take place after the event, after thorough analysis. The apparatus is preferably made to be modular, so that it can be easily adapted to different applications. The measurements sensor is a single compact package containing measurement cells and galvanically insulated electronics. The actual data processing, detection, and maintenance of the directional vector library takes place by means of a separate commercial, high-speed, powerful microprocessor card, such as the PC-104. The other elements are independent packages, which are connected to each other with the aid of a fixed flow channel.

According to Figure 2, the electrochemical measurement liquid-flow circuit includes a valve 12, a sensor unit 16, flow meters 17, a pH measurement sensor 15, and temperature measurement 18.

The sample line is formed to be so spacious and flexible, that it is not even necessary to filter fibrous samples. This avoids the change in samples caused by filtering.

The actual substance detection sensor is preferably comprised of six or more measurement cells, which are located radially around a bias-electrode.

In the arrangement according to Figure 3, the working electrodes 27 in the measurement cell 16 are tuned to be sensitive to the substances to be investigated by using a differential amplifier to feed current through each counter-electrode 29 and a solution to the working electrode 27, until the target potentials are achieved between the working electrodes 27 and the reference electrodes 28. The amount of current is determined by the target potential, the properties of the solution, and the materials of the working electrodes. The target potentials are determined from the polarization curves run using a measurement device. Alternatively, the measurement is carried out galvanostatically, in which case the current value is set to be constant and the voltage responses are measured as

the solution changes. It is advantageous to run small alternating voltage components on top of the direct-current voltage input, as this increases the reliability of the measurement.

The base level of the apparatus's measurement is set, for example, as the current-signal levels of the measurement cells, which are obtained using a pure liquid, for example, water. The base level is updated from time to time in the apparatus's memory, if its rate and degree of change are not greater than the predefined levels. When kitchen salt, for example, is added to pure water, the current-signal levels change in relation to the base level and compared to each other. The added substance and the amount of it are determined from the relative changes in the measurement signals obtained.

Each measurement cell has its own analog measurement electronics card, and the measurements relating to the diagnostics themselves. The analog card is connected by a bus to the computer of the measurement sensor.

The measurements can also be made by using only the voltage differences between the reference and working electrodes, without current input, which provides its own input space.

The software is divided into several different sub-areas: measurement of the rest potentials, running of the polarization curves, learning the substances to be detected and the disturbance substances and the actual process situation detection. The running of the polarization curves takes place by giving the measurement cell the initial and final potentials, the change potential, and the levelling time. The liquid used is a so-called pure liquid for study, for example, pure groundwater. The angle coefficient between the so-called Taffel's straight lines, which depict the concentration in the solution at any one time, can be derived from the polarization curves.

Next, the run is started, when the potentiostat is given the initial potential as the target and the potentiostat runs between the reference and working electrode to the desired voltage, by feeding current through the counter-electrode and the solution to the working electrode. The potential remains in this potential value for the levelling time, after which the current is measured. Next, the potentiostat is given a new target, which is a change potential greater than the previous target value. The potential again remains at this value for the levelling time, after which the current is measured again. This procedure is continued, until the final potential is reached. A curve is plotted from the potential and current values thus obtained, from which the desired target potential can be seen. A target potential from the horizontal part of the polarization curve, in which the electrochemical reactions and thus the current signals provided by the sensor are at a minimum, is selected for each pair of electrodes.

In the teaching and detection situations, the potentiostats are set to these target potentials and the sensor's current signals obtained with these target potentials are the so-called sensor's base level, with which the changes are compared.

The measurement sensor 16 according to Figures 3 and 4 includes a base component 22, a channel plate 20, an electrode cover 19, a circuit card 40, and a cover plate 21. In base component 22, there is an intake channel 23, which, in channel plate 20, divides radially into measurement channels 25, at the ends of which are outlet channels 24 that penetrate the electrode cover. These are joined together in pairs, with the aid of intermediate channels 30, in cover plate 21, in which there are also connections 31, leading away from intermediate channels 30, and to which the rotameters that are disclosed later are connected by means of connectors 32.

Cover plate 20 and electrode cover 19 are made from Teflon. Electrodes 26, 27, 28, and 29 are attached to electrode cover 19 in such a way that one end of them extends to channel 25 and the opposite end can be connected directly to circuit card 40. The said electrodes are set radially according to the flow channels 25. The bias electrode 26 is located at the intake channel 23. It also contains a high-speed temperature sensor (PT-100).

Measurement channels 23, 25, 30 are arranged to be so spacious that even liquid with a fibre content can pass through them without causing a danger of blockage. The radial channels 25 have a diameter of 0,3 - 3 cm, preferably 0,7 - 1,3 cm, while each electrode 27 - 29 protrudes into the channel in such a way that the speed of flow increases substantially at it (15 - 35 %). The surface area of the electrode in the channel is about 1 cm^2. The fibre and filler particles keep the electrodes clean.

A protectively earthed cylinder, which extends to at least one-third of the depth of electrode cover 19, is arranged around electrodes 27 - 29 on the circuit card 40 side. This has been observed to reduce the noise level considerably.

The materials of the pairs of electrodes are selected according to the desired application. What is essential is that each pair of electrodes is separate and measures the properties of the sample in its own voltage range. The electrode materials can be, e.g. platinum, gold, silver, iron Fe_3, iron Fe_2, stainless steel, molybdenum, zink, titanium, cadmium, copper, glass, electrically-conductive plastic, ceramics.

Odour data is gathered from the process liquid by allowing the gases to travel over the free surface of the liquid to a gas chamber, from where the gas is led to the odour sensors.

Figures 6 and 7 show the exit-flow arrangement of the sensor. Flow meters 35, in this case rotameters, are connected by connectors 32 and through exit channels 31 to intermediate channels 30. Regulator valve 35' is used to adjust the flow to be equal in each line. The outlets of flow meters 35 are connected to a single distributor piece 36, inside which a sensor of pH-meter 37 is placed. A common outlet line 38 is connected to the centre of distribution piece 36.

A water trap 39, which prevents the pH-sensor from drying out during a shutdown, is connected to outlet connection 38. In the same way, liquid also remains in the measurement cell itself, preventing electrodes 26 - 29 from drying out.

In terms of the operation of the sensor according to the invention, it is essential that the pre-amplifiers connected to the electrodes are assembled in compact circuit card 40, Figure 7. The electrode series are connected directly to the circuit card's connector series 41, in which there are individual conductor connectors 42 for the electrodes themselves and other conductor connectors 43 for the protective earthing. The preamplifiers are located in the space 44 between the radial series of electrodes, minimizing the connection distance. With the aid of the circuit card, the amplified measurement signals are led to the area 45 outside the sensor frame, in which there are circuits for processing the measurement signals, and output connectors.

Claims claims amended 25.2.2002

1. A method for analysing a papermaking process, in which several electrochemical quantities are measured from at least one liquid flow and fingerprints according to various process situations are determined, to which the fingerprints obtained in a normal process situation are compared and the differences in the output variables created by an essential change are determined, characterized in that the electrochemical measurements are carried out independently of each other using at least 4 - 15 electrode series, each comprising at least three electrodes, one common bias-electrode for all series and, in addition, at least one odour measurement is used from the gases that are emitted from the said liquid flow into the gas space over the free liquid surface.

2. A method according to Claim 1, characterized in that the odour measurements are made in at least two temperature ranges.

3. A method according to Claim 1 or 2, characterized in that the measurements are made from at least one liquid flow containing fibres and the measurement channels (23, 25, 30) are arranged to be sufficiently spacious so that liquid containing fibres can pass through them without causing a danger of blockage.

4. A method according to one of Claims 1 - 3, characterized in that there are six electrochemical electrode series (26 - 29) and their outlet channels (24) are connected together in pairs and these pairs are connected in turn through a flow meter (35) to a common outlet line (38).

5. An electrochemical, i.e. polarographic/galvanostatic sensor for analysing a liquid, in which sensor there is a measurement cell, through which the liquid is led and in which there are several working electrodes (27) of different material and

reference-electrodes (28) and a current-supplying counter-electrode (29), and a pre-amplifier to amplify a weak measurement signal, characterized in that the electrodes are arranged in electrode series (26, 27, 28, 29) each series including at least a working electrode (27), a reference electrode (28) and a counter-electrode (29), and there is a common bias-electrode (26) for all electrode series, which is a fourth electrode in each series, and there are 4 - 15 electrode series, each serie having own pre-amplifier with a minimized connection distance.

6. A sensor according to Claim 5, characterized in that the electrode series are placed in measurements channels (25) branching out radially of the intake channel (23) and the common bias electrode (26) in the centre of the intake channel (23).

7. A sensor according to Claim 5 or 6, characterized in that the material of at least one electrode (26, 27, 28, 29) belongs to the group: platinum, gold, silver, iron Fe_3, iron Fe_2, stainless steel, molybdenum, zinc, titanium, cadmium, copper, glass, electrically-conductive plastic, ceramics.

8. A sensor according to Claim 5, 6, or 7, characterized in that the pre-amplifier connected to each series is located in the space (44) between the electrode series in the immediate vicinity of each electrode series (27 - 29).

9. A sensor according to Claim 8, characterized in that the sensor includes an electrode cover (19) covering the radial channels (25) on at least one side, to which the electrodes are attached to extending into the said channels (25) and on the other side extending to a special electronic circuit card (40), in which the said pre-amplifiers are installed.

10. A sensor according to Claim 9, characterized in that a protectively ground cylinder, which extends over at least one-

Art. 34

third of the depth of the electrode cover (19), is fitted around the electrodes (27 - 29) on the circuit card (40) side.

11. A sensor according to one of Claims 5 - 10, characterized in that the sensor pipes are arranged in such a way that liquid remains around the sensors during a shutdown.

12. A sensor according to one of Claims 6 - 7, characterized in that the radial channels (25) have a diameter of 0,3 - 3 cm, preferably 0,7 - 1,3 cm and each electrode (27 - 29) protrudes into the channel in such a way that the speed of flow increases substantially at it.

13. A sensor according to one of Claims 6 - 10, characterized in that the electrode (26) in the centre of the intake channel is a high-speed temperature sensor.

AMENDED SHEET

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 April 2001 (12.04.2001)

PCT

(10) International Publication Number
WO 01/25774 A1

(51) International Patent Classification[7]: G01N 27/27, 27/403, 27/48, 27/49 // 33/34

(21) International Application Number: PCT/FI00/00861

(22) International Filing Date: 6 October 2000 (06.10.2000)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:

19992158	6 October 1999 (06.10.1999)	FI
20000111	20 January 2000 (20.01.2000)	FI

(71) Applicant and
(72) Inventor: LAITINEN-VELLONEN, Sakari [FI/FI]; Jokirannantie 3 A 4, FIN-40420 Jyskä (FI).

(74) Agent: KESPAT OY; P.O. Box 601, FIN-40101 Jyväskylä (FI).

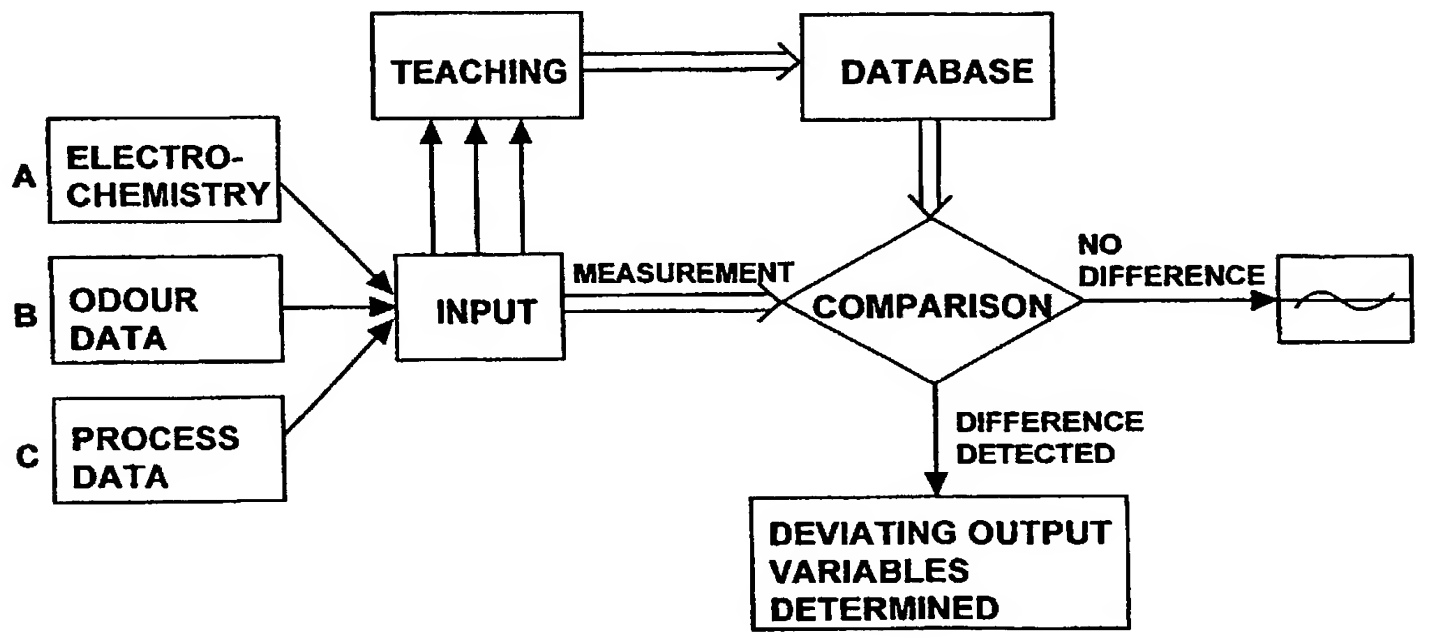
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*
— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD FOR ANALYSING A PAPERMAKING PROCESS AND AN ELECTROCHEMICAL SENSOR FOR ANALYSING LIQUID



(57) Abstract: The invention relates to a method for analysing a papermaking process, in which several electrochemical quantities are measured from at least one liquid flow and fingerprints according to good process situations are determined. The electrochemical measurements are carried out independently of each other using at least three electrode series, each comprising at least three electrodes. In addition, at least one odour measurement is used from the gases that are emitted from the said liquid flow into the gas space over the free liquid surface.

WO 01/25774 A1

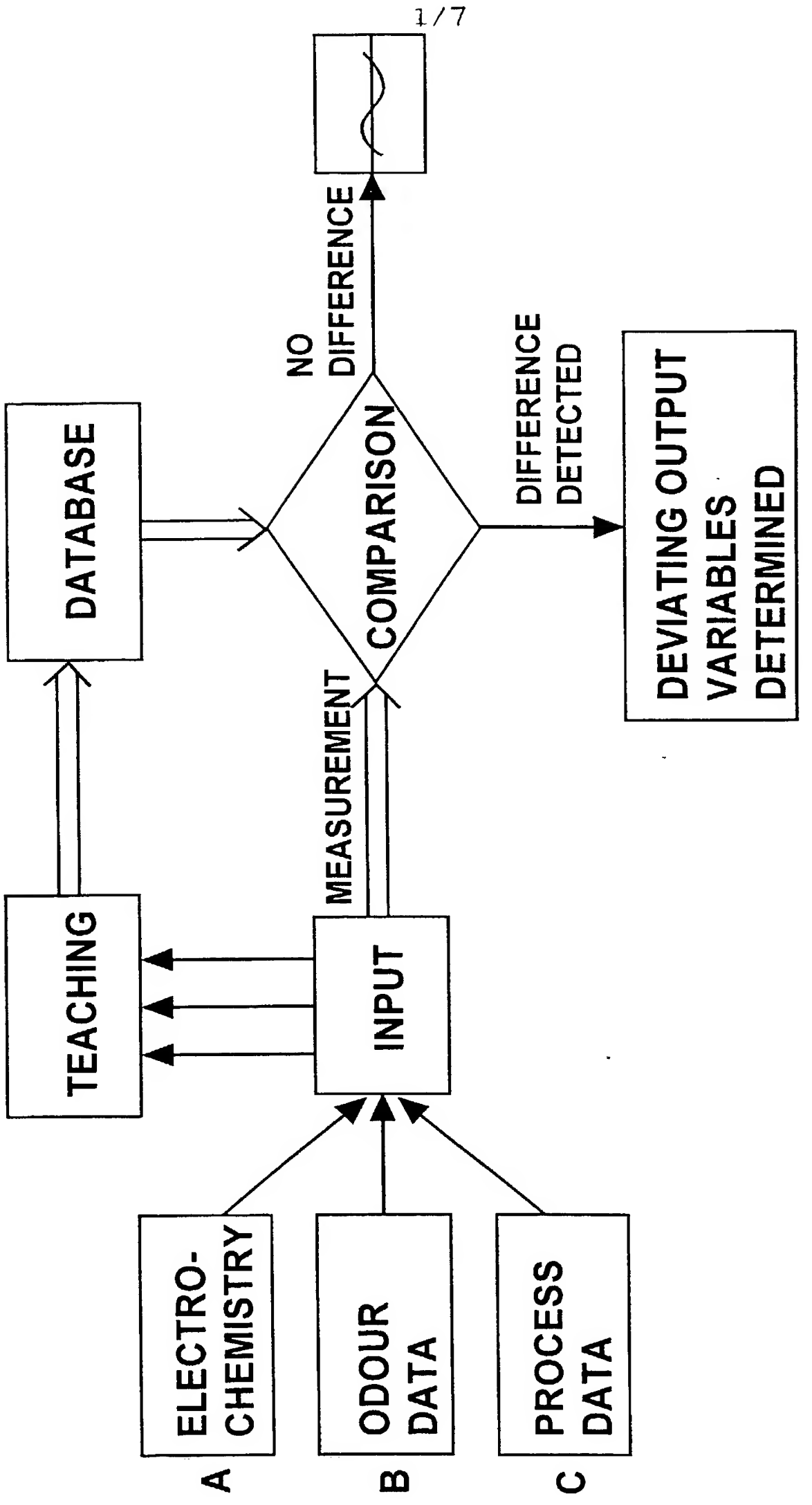

DATABASE
COMPARISON
NO DIFFERENCE
DIFFERENCE DETECTED
DEVIATING OUTPUT VARIABLES DETERMINED
TEACHING
INPUT
MEASUREMENT
ELECTRO-CHEMISTRY
ODOUR DATA
PROCESS DATA
A
B
C

Fig. 1

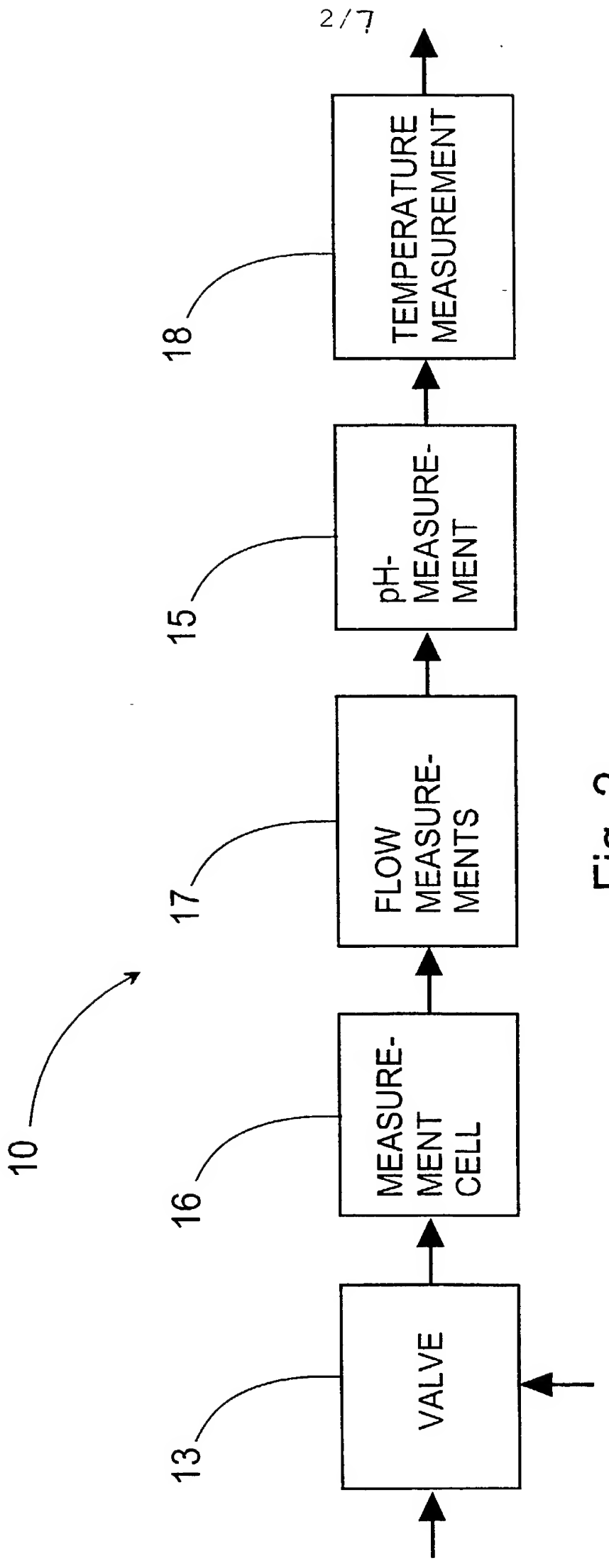

10
13
VALVE
16
MEASURE-
MENT
CELL
17
FLOW
MEASURE-
MENTS
15
pH-
MEASURE-
MENT
18
TEMPERATURE
MEASUREMENT

Fig. 2

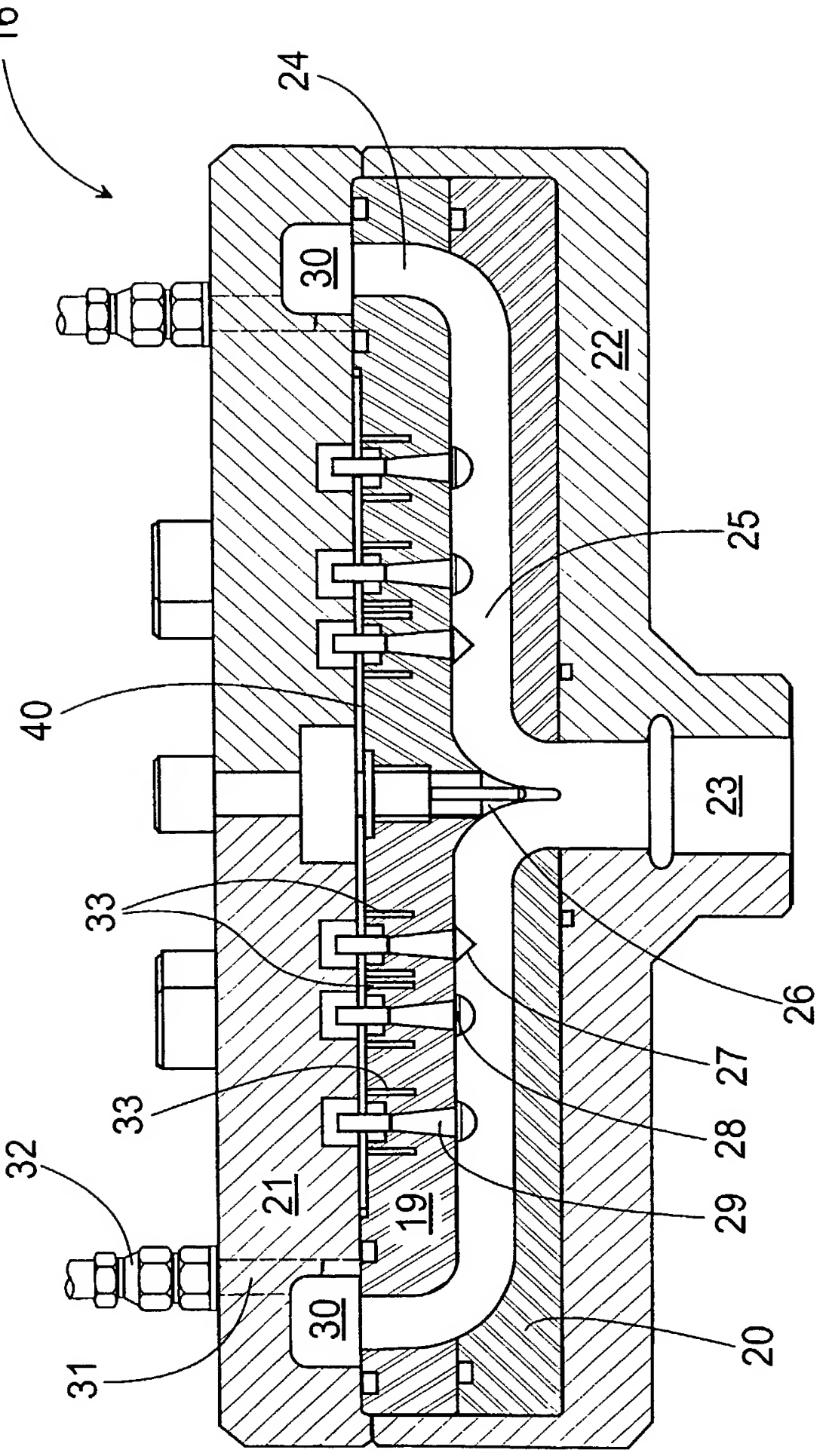


Fig. 3

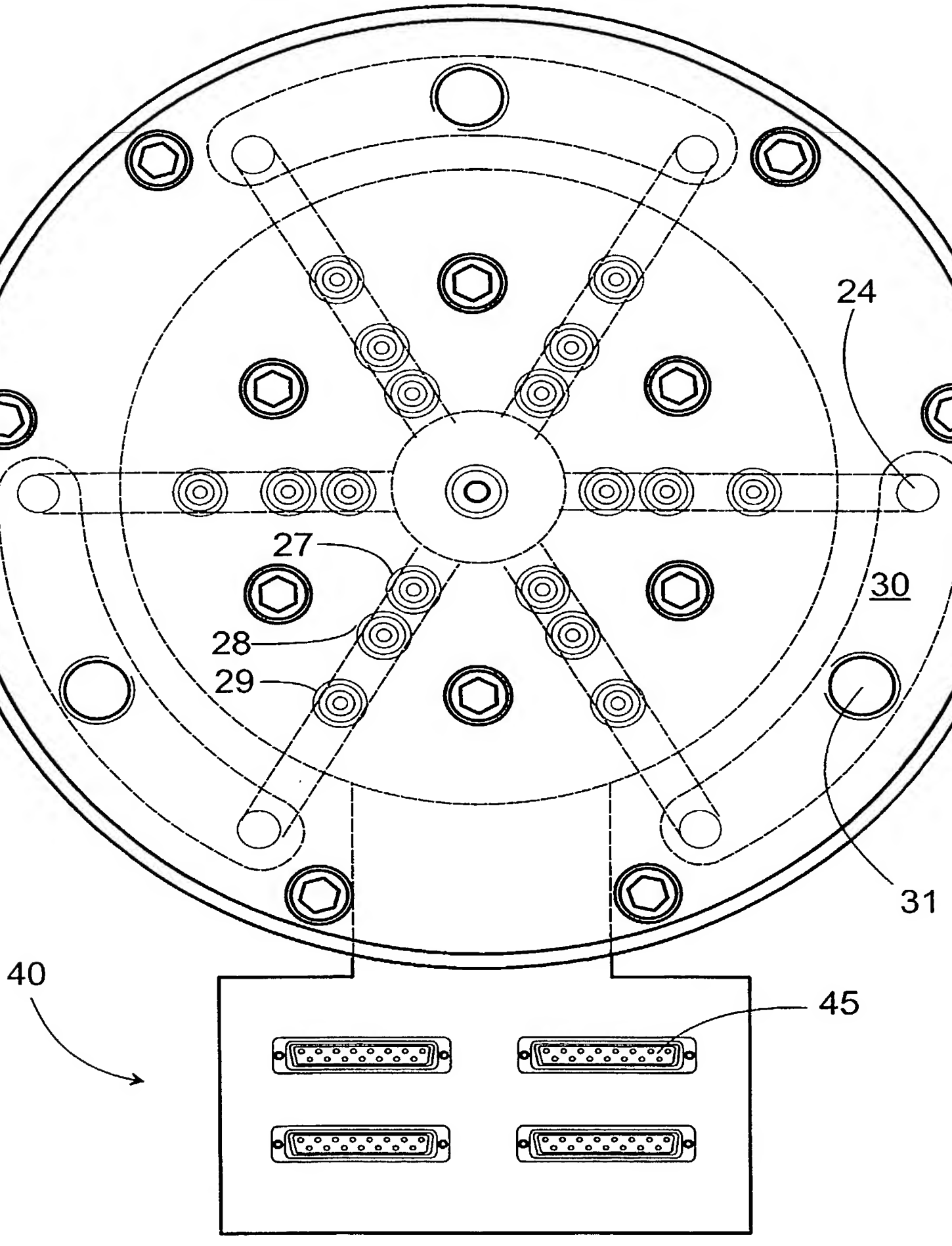


Fig. 4

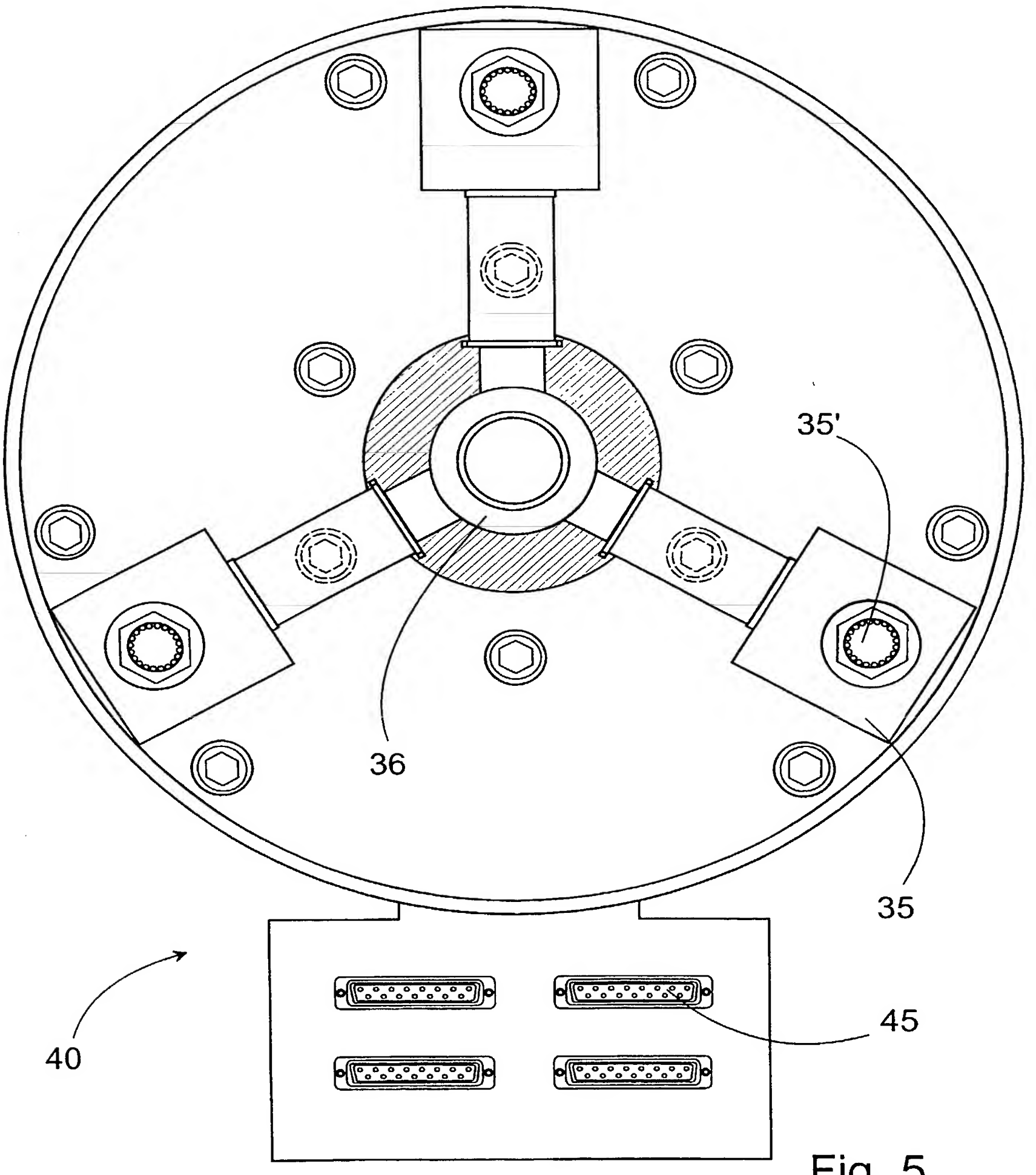


Fig. 5

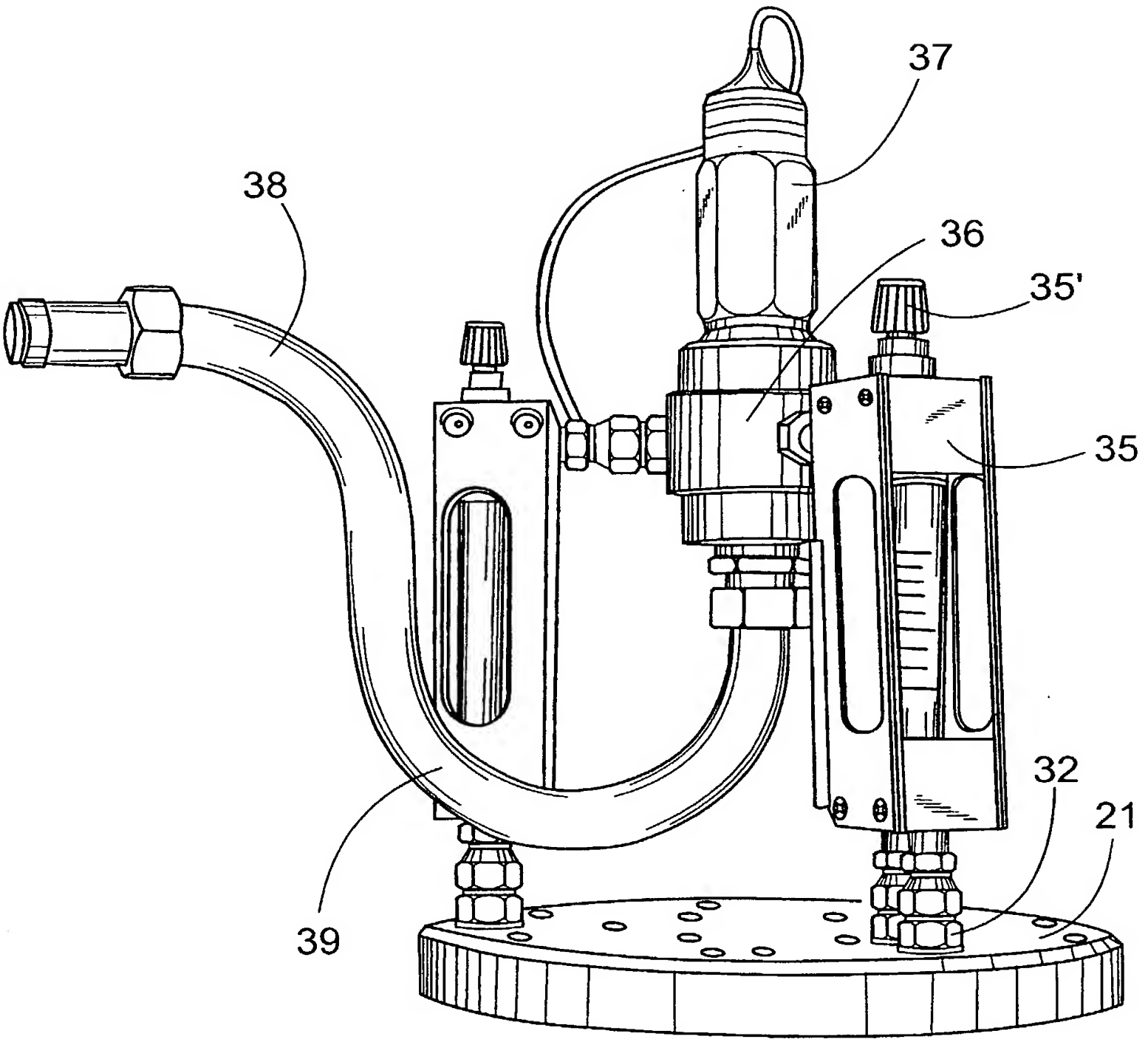


Fig. 6

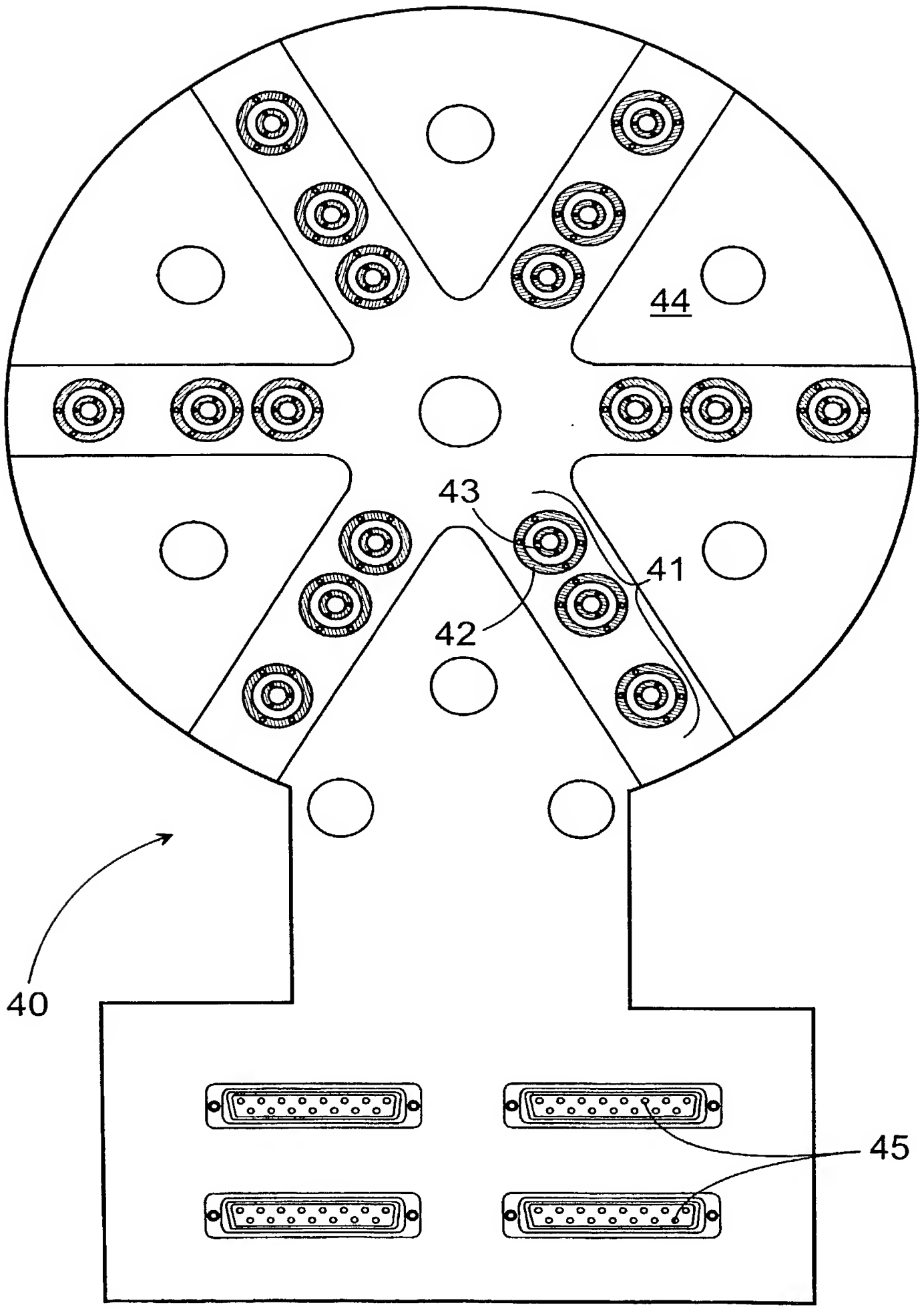


Fig. 7

Docket No. 11001.094

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled Method for Analysing a Papermaking Process and an Electrochemical Sensor for Analysing Liquid the specification of which
(check one) [X] is attached hereto.
[ ] was filed on _____: as Application Serial No. _____
and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):			Priority Claimed
19992158 (Number)	Finland (Country)	06/10/1999 (Day/Month/Year Filed)	Yes
20000111 (Number)	Finland (Country)	20/01/2000 (Day/Month/Year Filed)	Yes

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.)	(Filing Date)	(Status - patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

3 Christopher J. Fildes, Reg. No. 32,132; Robert J. Outland, Reg. No. 22,197
Edward P. Barthel, Reg. No. 20,717

Address all correspondence and telephone calls to Christopher J Fildes
Fildes & Outland, P C , 20916 Mack Avenue, Suite 2, Grosse Pointe Woods, Michigan 48236 - (313) 885-1500

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-10 Full name of sole or first inventor Sakari Laitinen-Vellonen

Inventor's signature [signature] Date March 25, 2002

Post Office Address same as residence Citizenship Finland

Residence Jokirannantie 3 A 4, FIN-40420 Jyskä, Finland FIX

405DECL usa

SCANNED,# 8

United States Patent & Trademark Office

Office of Initial Patent Examination -- Scanning Division

Application deficiencies found during scanning:

☒ Page(s) 10 - 12 of the specification were not present for scanning. (Document title)

☐ Page(s)_____ of_____ were not present for scanning. (Document title)

▫ ***Scanned copy is best available.***